Miami-Dade Water and Sewer Department

The Miami-Dade Water and Sewer Department's Consent Decree Program Experience

Sanitary Sewer Overflow (SSO) Report

June 2006

Miami-Dade Water and Sewer Department
P.O. Box 33-0316, Miami, FL 33233-0316

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CHAPTER 1 BACKGROUND

1.0 INTRODUCTION

Miami-Dade County, the southernmost urban area in the United States is located on the southeastern tip of the Florida peninsula and encompasses more than 2,000 square miles. It is among the 25 most populated Metropolitan Statistical Areas of the United States with an estimated population of 2.2 million. In addition, on any given day, there are about 135,000 transients.

There are 34 municipalities in the county, from the City of Miami to some small towns covering less than one square mile each. The area enjoys a subtropical marine climate with an average yearly temperature of 75 degrees Fahrenheit and an average annual rainfall of 60 inches. It is relatively flat with a maximum elevation of 23 feet above mean sea level (MSL). Drainage control is the result of a complex system (conservation areas, canals, levees, etc.) managed by the South Florida Management District and the county to serve multiple purposes (recharge, water supply, prevention of saltwater intrusion, etc.)

Bordered on three sides by national parks, the county is underlain at a shallow depth by the Biscayne aquifer, its sole water supply source. Groundwater levels are generally high, varying during the wet season, from 3 feet above MSL along the coast to 7 feet above MSL inland. Soils are generally poorly drained, with severe limitations for onsite wastewater disposal.

The Miami-Dade Water and Sewer Department (MDWASD), a Department of Miami-Dade County, is the regional water and wastewater utility, providing water service for over 400,000 retail water customers and 16 volume sewer customers. The wastewater collection system conveys flows of over 320 million gallons per day (MGD) to three (3) regional treatment plants. The Department is now the largest water and wastewater utility in the southeastern United States. Currently, MDWASD's sewage collection system consists of, approximately, 73,000 manholes, 2900 miles of gravity sewers, 880 miles of force mains, and 2,000 miles of laterals that make up almost 1,000 collection basins.

As is the case with most utilities, MDWASD had historically focused on plant expansions rather than on maintaining and rehabilitating its collection system, since most federal funds were available for increasing plant capacity. To compound the problem, the Department was formed from several County Divisions, cities and over 30 private utility companies. Consequently, the Department inherited a mixed bag of collection systems that, in some cases, were over 40 years old, and were not adequately maintained.

In addition, antiquated design methods were employed. Oversized force mains caused widespread cavitations and in several instances blew out manhole covers. The use of manual air release valves and using certain pipe materials encouraged corrosion instead of inhibiting it, as intended.

By 1991, it was evident that nearly one-half of the collection system was either in a state of disrepair and/or there was insufficient capacity to handle peak flows. In addition, knowledge of the collection system and how it operates was limited. The existing documentation was found to

be incomplete for such items as an inventory of the collection system, flow data for dry and wet weather conditions, sanitary sewer overflow data, flow routing capabilities, inspection and maintenance records, and illegal stormwater connections.

1.1 MIAMI-DADE COUNTY'S SSOs

As with other large utilities, MDWASD experiences its share of sanitary sewer overflows (SSOs). SSOs are discharges of raw sewage from municipal sanitary sewer systems. SSOs can release untreated sewage into homes or out of manholes and onto city streets, playgrounds and into streams or rivers before it can reach a treatment facility. However, occasional unintentional discharges of raw sewage from municipal sanitary sewers occur in almost every system.

SSOs are commonplace in the United States, where the average age of the over one million miles of sanitary sewers is, on average, 33 years old. In fact, EPA estimates between 23,000 and 75,000 SSO events per year occurring in the United States, discharging a total volume of between three and 10 billion gallons.

The EPA has grouped SSOs into five broad categories: blockages, wet weather and I/I, power mechanical failures, line breaks and miscellaneous (e.g., vandalism, contractor error, etc.) In addition, the following conditions found in Miami-Dade County are conducive to causing SSOs:

- The wastewater collection and conveyance system is comparatively old, with many of the major pipelines and interceptors over 30 years old.

- The service area is largely flat with a high groundwater table that is often only two or three feet below ground surface and tidal influences exist in the coastal areas. (This is partially responsible for the excessive I/I contribution to total wastewater flow.)

- The average annual rainfall is 60 inches, and frequent tropical storms can inundate a service area in a matter of minutes.

- Many areas of Miami-Dade County do not have adequate drainage facilities, but rely on percolation as a means to dissipate stormwater.

1.2 FDEP SETTLEMENT AGREEMENTS

In the late 1980's and early 1990's, MDWASD experienced a series of sewage overflows in its wastewater collection and transmission system, which led to enforcement actions from the United States Environmental Protection Agency (EPA) and the Florida Department of Environmental Protection (FDEP). Over a two-year period, MDWASD negotiated two separate Consent Decrees with the EPA and two separate Settlement Agreements with the FDEP that mandated over $1 billion in improvements to Miami-Dade County's wastewater facilities. In essence, these improvements required the implementation of short-term and long-term programs to minimize sanitary sewer overflows and to ensure that sufficient capacity exists within the wastewater facilities to allow for continued growth in Miami-Dade County.

MDWASD's Consent Decree/Settlement Agreement (CD/SA) Management Program has been in place since the signing of the first Settlement Agreement with FDEP, the Settlement Agreement Bay Crossing, in March 1993. In July 1993, a second settlement agreement, the Settlement Agreement Systemwide was entered into with the FDEP which mandated treatment plant expansion, odor control improvements at the CDWWTP, additional capacity throughout the collection and transmission systems and expansion of a detailed infiltration and inflow program.

1.3 EPA CONSENT DECREES

The United States EPA filed a federal lawsuit that raised the same issues covered by the FDEP. Their intent was to further the objectives set forth in the Clean Water Act by implementing remedial measures to minimize further unpermitted discharges in MDWASD's system. The U.S. Department of Justice, which represented the EPA, refused to acknowledge the existing FDEP settlement agreements. The County settled the suit by signing stringent consent decrees, in 1994 and 1995. In addition, Miami-Dade County paid $2 million to the U. S. Treasury, at the time, the largest penalty ever collected under the Clean Water Act.

The key components of the Consent Decrees included replacement of the 72" Cross Bay line, improvements at the three wastewater treatment plants, construction of regional pump stations and force mains, the rehabilitation of over 500 pump stations, implementation of an infiltration/inflow and gravity sewer rehabilitation program, miscellaneous operation and maintenance improvements, and long-term corrections to the system based on the results of a peak flow study.

According to Adam Kushner, the Justice Department's chief attorney on the Miami-Dade case, the government filed suit to protect public health, but also to secure its own investment. The County had used $300 million in federal funds to expand its system over the last 25 years, he noted, but spent little to keep it in shape. "We're working at the confluence of two principal problems—unstemmed growth that limited hydraulic capacity and a failure to invest in O&M," he said.

1.4 EPA SSO GRANT

On October 4, 1998, the United States Environmental Protection Agency (USEPA) awarded, through the mechanism of direct line item appropriation in the Federal budget, a grant to the MDWASD in the amount of $1,305,000 to be used for Phase I Sanitary Sewer Overflow (SSO) Abatement Demonstration Projects. These include peak flow pilot programs as well as the evaluation and documentation of the impact of the MDWASD Consent Order experience, which is documented in this report.

CHAPTER 2 MDWASD'S CONSENT DECREE PROGRAMS

This report will deal mainly with the programs instituted as a result of the EPA mandated consent decrees, the First Partial Consent Decree (FPCD) and the Second and Final Partial Consent Decree (SFPCD).

2.0 PROGRAM MANAGEMENT FOR THE CONSENT DECREE PROGRAM

MDWASD faced some unique challenges in implementing its Consent Decree Program. MDWASD was required to comply with multiple enforcement actions imposed by two separate regulatory agencies, the EPA and FDEP, which were not consistent and, in some cases, were in direct conflict with one another. Since the volume of work required was significantly greater than the Department could handle in-house and since the time frames were extremely tight, MDWASD decided to hire a Program Manager to help monitor and direct the successful completion of this work. In April 1994, Montgomery Watson, a Pasadena, California consultant, was authorized to serve as the Department's Program Manager for the work associated with the various enforcement actions. In addition, more than 20 engineering consultants were utilized to manage subprograms and perform engineering work. MDWASD also increased its staff in response to the enforcement actions.

Simply defined, program management is a focused approach led by a dedicated team for long-term inter-related projects to achieve specific objectives by a definite date within budget. It is a management approach that allows significant flexibility in approach to organization structure, function and level of effort. The most important factor is that the assigned staff, whether they be consultants or department staff, be fully dedicated to the program. The "Program Management Approach" is typically used when one or more of the following conditions exist or are desired:

- Insufficient in-house resources
- Tight schedule and budget
- Single point of responsibility
- Improve skills of in-house staff
- Uniform approach on multiple projects

Typical services most frequently performed by the Program Manager are as follows:

- Program controls, scheduling, and document control
- Planning and project definition
- Permitting, easements and rights-of-way
- Pre-design, design coordination and design review
- Construction management, including inspections
- Operator Training
- Public relations

MDWASD's Program Management experience continues to be a positive one and has enabled the Department to comply with the numerous, stringent mandates imposed by the Consent Decrees.

In 1999, the MDWASD went through an extensive reorganization. Subsequently, the Consent Decree/Settlement Agreement (CD/SA) Management Section was created. The Section's mission was to assume the functions being performed by the program management team and the various engineering consulting firms, who had been handling the programs which were instituted as a result of the consent decrees and settlement agreements.

The CD/SA Section's initial goal has been accomplished as the Department has successfully transitioned the Pump Station Improvement Program (PSIP), the Consent Decree/Settlement Agreement (CD/SA) Compliance Reporting Program, and the Infiltration/Exfiltration/Inflow (I/E/I) Program responsibilities, previously handled by consultants, to in-house staff.

2.1 CONSTRUCTION OF A NEW CROSS-BAY LINE

The First Partial Consent Decree (FPCD) with the EPA specified replacement of the 72" Cross Bay line, which carried wastewater from the mainland to the Central District Wastewater Treatment Plant on Virginia Key, with a 102" diameter line. The existing Cross Bay Line was over 40 years old and inspection was impossible. The new 102" Cross Bay Line was fast tracked and completed one year ahead of schedule and $12 million under budget. Once the 102" line was completed, and inspection of the 72" was possible, it was determined that only minor rehabilitation of the latter was required.

2.2 PUMP STATION IMPROVEMENT PROGRAM

MDWASD instituted The Pump Station Improvement Program (PSIP) in response to the requirements imposed by the FPCD. The PSIP is a $300 million program, which began in April 1994, to upgrade the collection system pump stations and force mains.

The FPCD required that adequate transmission capacity be demonstrated by MDWASD's certification that each pump station immediately upstream from the pump station receiving flow from newly authorized sewer service connections, and all pump stations through which flow from the newly authorized sewer service connections pass to the wastewater treatment plant receiving flow, exhibit a nominal average pump operating time (NAPOT) of less than or equal to ten (10) hours per day.

Pump stations exceeding the 10-hour per day NAPOT criteria require that a Remedial Action Plan be prepared. The FPCD prohibits the issuance of any building permits authorizing the discharge of wastewater to that portion of the collection system where adequate transmission capacity does not exist until a Remedial Action Plan has been incorporated, including a schedule for completion, to ensure adequate transmission capacity. No new sewer service connections can be authorized and no building permits can be issued until adequate transmission capacity can be demonstrated.

In accordance with the FPCD, a total of 360 Remedial Action Plans were prepared and submitted to the EPA in November 1993. Since then, a total of 242 additional Remedial Action Plans have been prepared and submitted to the EPA per the requirements of the FPCD through December 31, 2005. To date, 588 pump station and 205 force main projects have been completed. (See **Figure 1** for the PSIP Program at a Glance.)

In addition, to comply with the SFPCD, MDWASD inspected all pump stations within its collection system for the purpose of identifying any equipment malfunctions or physical deficiencies. The correction of all equipment malfunctions or physical deficiencies found during these inspections has been completed. In addition, repairs to pump stations which caused or contributed to overflow conditions was completed within 60 days of the overflow event and upgrades of overflow pump stations were completed by the compliance dates stipulated in the SFPCD.

The PSIP has resulted in the following positive results:

- NAPOT reduction for the entire system by approximately 60% since inception of the PSIP.
- Completion of systemwide flow transfer upgrades to allow diversion of wastewater to any of the three treatment plants resulting in a reduction of treatment plant violations and overflows.
- Reduction in the number of sanitary sewer overflow events.
- Continued economic growth within the MDWASD service area as a result of developer coordination efforts.
- Coordination with the I/E/I Reduction Program to help establish priorities that also saved both I/I repairs and pump station upgrading costs.

2.3 INFILTRATION/EXFILTRATION/INFLOW (I/E/I) REDUCTION PROGRAM

I/E/I components are defined as follows. Infiltration is caused by leaks in the sewer lines that allow ground water to enter the sewer system. Because of South Florida's high water table, many sewer pipes lie below the water table. Consequently, any cracks or poor joint connections allow groundwater into the sewer. Exfiltration refers to sewage leaking out of the sewers. Inflow occurs when rainwater, which averages 60 inches per year in Miami-Dade County, enters the sewer system through broken cleanouts, improperly sealed manholes, and storm drain interconnections.

Although MDWASD had an I/E/I Program in place as early as 1992, as a result of SFPCD requirements, MDWASD instituted one of the country's largest I/E/I Reduction Programs. The goal of the I/E/I Program is to minimize the amount of groundwater infiltration and inflow from rainwater entering the sewer system, and to minimize the potential leakage of raw sewage from defective sewers contaminating ground and surface waters threatening the already fragile South Florida ecosystem.

In 1999, MDWASD met with the EPA to discuss the "Peak Flow Reduction Action Plan" which described how the I/E/I Reduction Program would be refocused to better address peak flows and reduce sanitary sewer overflows. As concurred at this meeting, the modified Program is focusing on leaking and non-leaking defects identified in high peak flow basins, leaking defects in low peak flow basins, and finally, significant structural problems.

Program Phases

The I/E/I Program consists of three phases that include the Inspection Phase, the Evaluation Phase, and the Construction Phase.

The Inspection Phase

The Inspection Phase of the I/E/I Reduction Program consists primarily of three major tasks. These tasks include manhole inspection, smoke testing, and closed circuit television inspection of the sewers. MDWASD crews perform all of the inspection activities except the cleaning and closed circuit television inspection of sewers that are 18 inches or larger in diameter.

Early on, it became apparent that in order to satisfy the reporting requirements of the Consent Decrees, MDWASD had to maintain an accurate inventory of its sewage collection system. The data collected during each inspection task provides updated inventory information. However, keeping an accurate inventory of the over 73,000 manholes which lie in MDWASD's sewer collection system is not an easy task. New manholes are added while others are removed from service or inadvertently buried due to system improvements and construction activities. As a result, sewer atlas maps were sometimes inaccurate and data conflicts were common.

This prompted the establishment of procedures to ensure continuous quality control checks on the inspection data. Field inspection crews are furnished with specially designed forms (see **Exhibit 2-1**) that allow them to record any anomalies between field conditions and the sewer atlas maps. The information recorded on these forms is entered into a Program database.

Manhole Inspections

At the onset of the Program, manhole inspections made in shallow manholes (less than 5 feet deep) were essentially above ground inspections. However, as deeper manholes were being inspected, the inspection procedures needed to be modified to ensure that accurate and detailed information was collected on each of the manhole components. To meet this objective, manhole inspection procedures were modified to allow for inspections to be made by physically descending into the manhole. This measure required that the manhole inspection crews be trained and certified in confined space entry requirements.

Smoke and Dye Water Testing

Smoke testing identifies potential sources of inflow in the sewage collection system. During smoke testing operations, the line segments to be tested are plugged and, if necessary, dewatered. A smoke cartridge is introduced through a manhole in one of the line segments being tested and smoke is blown from this manhole to the other adjoining manholes. As the smoke is pushed through the line segments, smoke test crews record defect locations which are determined by where the smoke is seen escaping to the surface. The locations of smoke test defects are sketched on smoke test forms. To assist the evaluation staff in documenting the location of a defect, its location from the upstream manhole and another fixed point of reference is noted on the sketch. In addition to the sketch, the smoke test crews also take a Polaroid photograph of the defect which is used as documentary evidence in the subsequent enforcement process.

Illegal interconnections are detected by a combination of smoke testing and dye water testing. During dye water testing, dye is introduced into the suspect storm sewer and the adjacent sanitary sewer lines are checked for the presence of the dye.

Smoke test defects are placed in five categories. These are defective main lines or service laterals (public right-of-way defects), positive stormwater/sanitary sewer interconnections, defective or missing clean out caps, defective clean out risers and defective house plumbing. MDWASD is responsible for repairing all defects that lie in the public right-of-way. The Department of Environmental Resources Management (DERM) is the local regulatory agency that is responsible for enforcing the repair of the other four categories of defects. Although DERM is responsible for the enforcement of missing or defective clean out caps, these defects are not directly reported to DERM. MDWASD field crews replace these defective/missing caps during smoke testing. It is considered more cost effective for MDWASD crews to replace the clean out caps at the time of testing, as the cost of these caps ($4.00) is minimal. This refinement to the enforcement process has resulted in savings in enforcement resources and has expedited the repair of this category of defect.

Closed Circuit Television Inspection

Initially, closed circuit television inspections were performed primarily with straight-line cameras. The use of straight-line cameras posed difficulties during the evaluation phase when the videotapes were being analyzed. Although straight-line cameras were able to detect cracked wyes, they were not able to detect defects in the service laterals that were in the vicinity of the wyes. In order to resolve this problem, a pilot study using cameras with pan and tilt capabilities was performed. The results indicated that about 60% of the suspected defective laterals contained defects in the vicinity of the wyes which could be identified and confirmed with pan and tilt cameras without the need to perform a separate suspect lateral inspection with a remote camera, which is a very time consuming process. This finding resulted in a decision to perform all closed circuit television of the sewers with pan and tilt cameras instead of straight-line cameras. Consequently, the number of suspect lateral investigations resulting from the main line television inspection of the sewer greatly decreased.

Suspect lateral investigations are part of the closed circuit television inspection process. As the camera moves down the main line, the TV camera pans and tilts all defects and lateral connections. When the camera arrives at a lateral connection the operator pans into the lateral connection to determine if there are any obvious defects in the lateral within view of the main line. If water is observed coming from the lateral the operator will hold his position for three to five minutes. If the water does not stop the lateral is identified as a suspect lateral and it is issued to a lateral inspection crew for complete inspection.

Evaluation Phase

During the Evaluation Phase of the Program, the data collected during the Inspection Phase is entered into a database and analyzed by a team of Evaluation Technicians. The use of a program database not only helps in the sorting and retrieving of this data but also aids in avoiding instances of repair work duplication. Only a single repair is recommended at a given location for defects which are detected by different inspection activities.

During this phase, each line segment televised is reviewed and each defect is noted by the reviewer. Information on the location and type of defect is recorded. In addition, the clock

reference position as well as the approximate I/I quantity associated with the defect are noted. The entire line segment is reviewed before any repair call is made resulting in a more economical and effective repair method to be chosen. For example, instead of requesting two separate point repairs and a sectional liner to repair three separate defects, it may be more cost effective to replace the entire line segment. The most cost effective repair is determined by analyzing available cost data, site conditions, and constructability issues.

The decision matrix used by the staff to identify repairs has evolved over the course of the I/E/I Reduction Program (see **Exhibit 2-2**). MDWASD has consistently sought a trade-off between repair costs, and the long-term effectiveness of each repair method. As a result, a New Technology Committee (NTEC) was created to keep abreast of new technologies which were being developed and introduced at a rapid rate. The NTEC evaluated and recommended the use of various new technologies. As a result, the use of trenchless repair technologies continued to increase and they now account for more than 60% of all sewer repairs completed as part of the Program. The increasing use of trenchless repairs over traditional “dig and replace” repairs has led to tremendous cost savings as the construction difficulties posed by a high water table and traffic disruptions are minimized.

In its comprehensive approach to I/E/I reduction, MDWASD had originally formulated a repair strategy that necessitated that all sewer defects be repaired. In view of the age of the collection system, this measure resulted in a large number of repairs to cracked lines. This situation prompted an investigation into the repair of cracks to the vitrified clay pipes. In this study, videotapes of line segments that were televised approximately five years apart were evaluated. The investigation yielded some interesting results. It was observed that dry cracks which were 6 inches and less in length and which were about one sixteenth of an inch or less in width, did not propagate further over the five year study period. Consequently, these types of cracks are not considered cost effective to repair provided that the segments remain undisturbed. This finding resulted in the modification of the decision matrix regarding repair of cracks and resulted in substantial savings over the life of the Program.

Flow Monitoring

In addition to analyzing the inspection data, the evaluation team also monitors the MDWASD gravity collection system basin flows. Particular attention is paid to the night flow data obtained from the basins. The night flow data is used to assess the severity of the I/E/I problems in a basin and, consequently, to prioritize I/E/I efforts among the various basins. Therefore, the integrity and accuracy of the night flow data is of particular importance.

At the onset of the I/E/I Reduction Program, night flow data was collected by MDWASD field crews primarily using the time-of-rise method. This method of flow measurement essentially involved a determination of the time it takes the wet well level in a pump station to rise a predetermined amount. Once this time is noted, the flow is computed by relating the volumetric rise in the wet well to the time of the rise. This method is simple but is prone to errors. Consequently, field crews began using portable flow meters to record night flows. The use of portable flow meters allows for a more accurate determination of the night flow as flows are monitored continuously for a 72-hour period. Currently, SCADA readings provide 85% percent of night flow information, resulting in reduced overtime and even greater accuracy. See Section 2.4.2 of this report for a more detailed explanation of SCADA.

The Construction Phase

Program repairs are realized via the use of construction contracts as well as in-house forces. Point repairs which require excavations are performed by both MDWASD and contractors. Department crews handle pipe sizes of 20" diameter or less; anything larger is bid out. Line replacement and trenchless repairs are performed primarily by contractors. Trenchless repairs include the use of fold and form liners and cured-in-place liners, sectional cured-in-place liners, joint grouting and robotic point repairs. There are a number of factors which determine the repair method chosen for a defective line segment. These factors range from the severity of the defect, the depth of the sewer, the number of defects in the line segment, whether the surface overlying the sewer is paved or unpaved, the presence of roots and the number of service connections in the line segment. All these factors have an impact on repair costs. In essence, a trade off between the effectiveness of a repair method and the costs involved must be made.

MDWASD's I/E/I Reduction Program has been very successful. The project database allowed the detailed tracking of thousands of defects and their subsequent repairs, following the stringent repair schedule mandated by the SFPCD. More than 32,000 consent decree mandated repairs were completed and as of February 2006, 152 MGD of I/I has been removed from MDWASD's system. In addition, by adhering to the structured I/E/I Reduction Program guidelines the most effective, long-term repair solutions were found.

One of the key indicators of the effectiveness of the I/E/I Reduction Program is the decline in wastewater flows to the three wastewater treatment plants that serve MDWASD's collection system. As can be seen from **Figure 2**, there has been a steady decline in the quantity of wastewater flowing to the treatment plants despite a continuously growing population and transmission system improvements.

2.4 PEAK FLOW MANAGEMENT STUDY PROGRAM

In accordance with the SFPCD, MDWASD is required to implement a program of pump station upgrades and collection system improvements to achieve long term adequate transmission capacity using data developed from a rainfall dependent Peak Flow Management Study that characterizes the infiltration/inflow into the collection system during rainfall events. To complete the Peak Flow Management Study, MDWASD personnel will utilize the Collection and Transmission System Model developed according to SFPCD requirements or, depending on an evaluation to be conducted, the steady state model for the system. To improve the accuracy of the model to be used, MDWASD is monitoring the system performance during wet weather to gain better information regarding flows and peak/average flow ratios.

In order to fully analyze peak flow issues, MDWASD created the Peak Flow Reduction Workgroup, the System Optimization Pilot Study, the Lateral Pilot Study, and the Wastewater Treatment and Disposal Capacity Workgroup. The Peak Flow Reduction Workgroup was directed to identify peak flows, determine the best way to reduce peak flows and find solutions for addressing the remaining peak flows that cannot be cost effectively and affordably reduced. The Wastewater Treatment and Disposal Capacity Workgroup's key objectives were to analyze the capacity of existing MDWASD treatment and disposal facilities and to identify short and long term upgrades to provide adequate capacity.

As per discussions with the EPA, the results for the System Optimization Pilot Study and the Lateral Pilot Study will be incorporated into the Peak Flow Management Study. These two pilot studies were initiated as a result of the current on-going study of rainfall dependent I/I (RDII), which indicated a strong linkage between peak flows and significant rainfall events in particular collection basins. The studies seek to analyze the beneficial effects of optimizing storage of the collection system, and examine in detail the impacts of lateral defects in the collection system on peak flows and the benefit of repairing those defects.

The Peak Flow Management Study Report will ultimately determine each station's ability to handle peak flows and provide a schedule of remedial actions, upgrading or improving each pump station in the collection system. The design for these upgrades or improvements shall be based upon a peak flow criteria as opposed to the previous 10-hour NAPOT criteria. The Peak Flow Management Study Report is currently due for submittal to the EPA on May 8, 2008.

2.5 MISCELLANEOUS REQUIREMENTS

2.5.1 Consent Decree Mandated Ordinances

The Consent Decrees required that Miami-Dade County institute ordinances to address problem areas. The FPCD required that MDWASD enact an ordinance, with a corresponding plan of implementation, requiring the elimination, to the maximum extent practicable, of the discharge of grease and oil from industrial and commercial users to MDWASD's system. The EPA approved the Grease Trap Ordinance and Plan of Implementation on April 13, 1994. Subsequently, the Grease Trap Ordinance (94-132) was enacted by Miami-Dade County's Board of County Commissioners on June 21, 1994 and remains in effect today.

The SFPCD required that Miami-Dade County propose for enactment a Volume Sewer Customer Ordinance (VSCO) and submit to the EPA a plan of implementation. The VSCO requires that all permitted public utilities and owners of private sanitary sewer collection systems (SSCSs) complete a Sanitary Sewer Evaluation Survey (SSES) of their respective public or privately owned or operated SSCS. Additional requirements include submittal of annual progress reports, certification of the SSCS transmission and treatment capacity, and various other mandates which mirror the SFPCD, including elimination of illegal stormwater connections. The VSCO became effective on November 12, 1997 and DERM continues with its implementation.

2.5.2 Supervisory Control & Data Acquisition (SCADA) System

The SFPCD mandated that MDWASD systematically install a Supervisory Control and Data Acquisition (SCADA) system throughout its collection system. MDWASD installed this pump station remote monitoring equipment in all pump stations according to the consent decree stipulated schedule. The SCADA system allows remote control of the pumping station and the ability to remotely change the parameters that control the pump station operation. The SCADA system also monitors, transmits and records data on the wet well levels, discharge pressures, pump status, intrusion alarms, high and low level alarms and power condition. Some selected sites also have recording rain gauges and groundwater level monitors connected to the SCADA system.

These SCADA capabilities allow the centralized control facility to identify, in real time, the condition of each pump station, the flows entering the station, and in some cases, the groundwater and rainfall levels affecting the station. The ability to monitor pumping status, wet well level and discharge pressure allows the centralized control facility to dispatch needed spare pumps, portable pumps or portable generators to any location immediately.

2.5.3 Operations & Maintenance Requirements

The SFPCD required that an inventory management system be developed for approval as well as the submittal of a critical spare parts inventory to the EPA. In addition, a Comprehensive Maintenance Program and Tracking System (CMPTS) was developed to satisfy Consent Decree requirements. The CMPTS consists of a report containing procedures and schedules of frequency for preventive and corrective maintenance.

2.5.4 Treatment Plant Optimization Program

A program was developed to optimize wastewater treatment efficiency and effectiveness at the North, South, and Central District Wastewater Treatment Plants (WWTPs). The program was completed using the EPA's Composite Correction Program (CCP). The first phase of the CCP, a Comprehensive Performance Evaluation (CPE) for each plant consisted of an evaluation of each plant's hydraulic and biological design capabilities, managerial, operational and maintenance procedures. The CPE report, which included the implementation schedule for recommended improvement projects, was submitted to the EPA on February 22, 1996 and subsequently approved. MDWASD has implemented and completed the ten recommended projects set forth by the CPE.

2.5.5 Supplemental Environmental Projects

MDWASD was required to undertake Supplemental Environmental Projects (SEPs) in the amount of $5 million, of which $1 million was designated for water conservation. The Community Action Agency, a department of Miami-Dade County government that operates as a Community Based Organization in Miami-Dade County, was responsible for the development, implementation and administration of the water conservation program. This involved the distribution and installation of 5000 ultra low flush toilets and 5000 low flow showerheads.

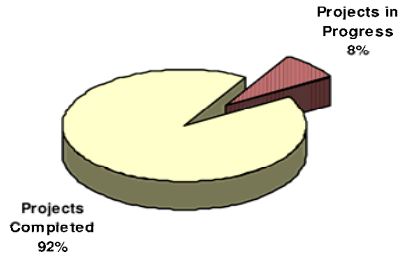
Four million dollars were spent on wastewater reuse SEPs. The Public Access Reuse projects included reuse facilities at the North, Central and South District WWTPs. Construction for the PAR projects was completed in the year 2000 and they were on-line and operational ahead of the compliance completion date of January 1, 2002, as required by the SFPCD.

MIAMI DADE WATER AND SEWER DEPARTMENT

Pump Station Improvement Program

PROGRAM AT A GLANCE

As of May 31, 2006



Budget Execution

Actual Budget	$303,284,378.81
Actual Expenditure	$280,833,562.89
Budget Balance	$22,450,815.92
Percent Expended	92.6%

* Actuals through March 31, 2006

PROJECT TYPE	Scheduling Status: Evaluation and Scoping	Contract Document	Permitting	Contract Procurement	Construction/ Certification	PROJECTS IN PROGRESS	Action list Status: Napot	Newpot	Specials	PROJECTS COMPLETE	TOTAL
Pump Stations	33	15		1	4	53	17	32	4	588	641
Force Mains	5	9			2	16			16	205	221
TOTAL	38	24		1	6	69	17	32	20	793	862

(Data date:May 31, 2006)

Prepared by: CD/SA Scheduling and Cost Control Unit File: 5DC.5.8.5 6/16/2006

Figure 1. PSIP Program at a Glance

EXHIBIT 2-1 Atlas Correction Form

Miami Dade Water and Sewer Department ***Sewage Collection Division***

Atlas Correction Form

Atlas Page:_____ PS:_____ Originator:_____

Date:_____

Comments:_____

Schematic:

Note: When numbering new manholes, please use the downstream manhole number, plus an alphabetic character. Example: for two new manholes upstream of manhole 5, name them 5A and 5B.

Segments to Add:						Segments to Remove:		Comments:
Upstream MH	Downstr MH	Length	Depth	Dia.	Pipe Material	Upstream MH	Downstr MH	

EXHIBIT 2-2 MIAMI-DADE SEWER SYSTEM REHABILITATION: REPAIR CRITERIA AND TECHNOLOGY (Summary)

General

-If cost of point of repairs (sectional or excavated) is within 20% of cost of full length repair (liner, line replacement), assign full length repair

-If there are medium to heavy roots in the joints throughout the entire length of the line, a liner should be assigned, after de-rooting regardless of infiltration

-Individual dry cracks, <1/6' wide and < 6" long, not cost effective to repair

-Pipe scratches and chips (not thru pipe wall) not cost effective to repair.

Grouting

-Used to seal leaking joints (will not seal cracks or breaks)

-Used to treat light joints (inhibitor added to grout)

-Used to seal rolled joint gaskets

-Cannot be used on joints directly adjacent to laterals

-Cannot seal deteriorated pipe

-A grout packer is pulled through the line at each joint, the packer is expanded and grout is pushed into the surrounding soil through the joint

Sectional Liner

-Can handle all repairs except for partial or total line collapse

-Liner maximum length is 9 ft. Multiple defects can be addressed within that length

-when assigned to defects adjacent to laterals or drop connections in service, the services have to be re-instated.

-Used on multiple cracks located in one section (spider wed type)

-Used for cracks with active infiltration or stains

-If more that one segment has joint to joint crack, then consider full length liner

-Rule of thumb: sectional repairs only for less than one defect per 100' of line, or maximum of 3 per line. Anything greater, consider full length liner
-If line <50' in length, then use full length liner

Point Repair

-Only way to repair medium to **heavy** roots in lateral

-Use on collapsed pipes or jagged edges or offsets >1"

-Specified to replace up to 15' of line per repair

-For broken drop connections

-Often used in conjunction with liner

-Rule of thumb: when the line isn't in a rear easement: point repairs only maximum 3 per line. Anything greater, consider replacing the line as a last resort!

-If lines are in rear easements and restoration costs are high (i.e. trees, swimming pools). Make point repairs and consider one of the liners when ever possible

Cured in Place Liners

-Used on diameters 8" and up. Can handle minor sand & infiltrations

-Used when lines have breaks or jagged edges that could cut a fold and form liner as it is dragged through the line

-Do not use when offsets >1"

-Do not use when pipe out of round by more than 5%

Repair damaged lateral connections prior to issuance

-Liner is pushed inside-out through sewer pipe with water pressure

-Once in place, liner is cured with hot water

-Laterals are cut and grouted once liner is cooled

-Generally more expensive than fold & form

Line Replacement

-Used as a last resort!

-Used when joints are severely offset
-Used when there are heavy sags throughout line

-Used when 3 or more point repairs requiring excavations, such as broken lateral connections are required.

Try not to use in rear easement, if possible use a liner.

Pipe Bursting

-Use if line must be replaced but restoration is excessive or open cutting is not possible

-Requires insertion and machine pits at either end of line segment and pit for every lateral connection

-Use for increasing pipe diameter

-Try not to use in rear easements, if it is possible, use a liner.

Caveat

While the criteria above are used for a general guideline in choosing the proper repair technology, the number of variables and special conditions make a rigid set of guidelines unsuitable. The I/E/I team is trained to make the best possible decision based on the available data.

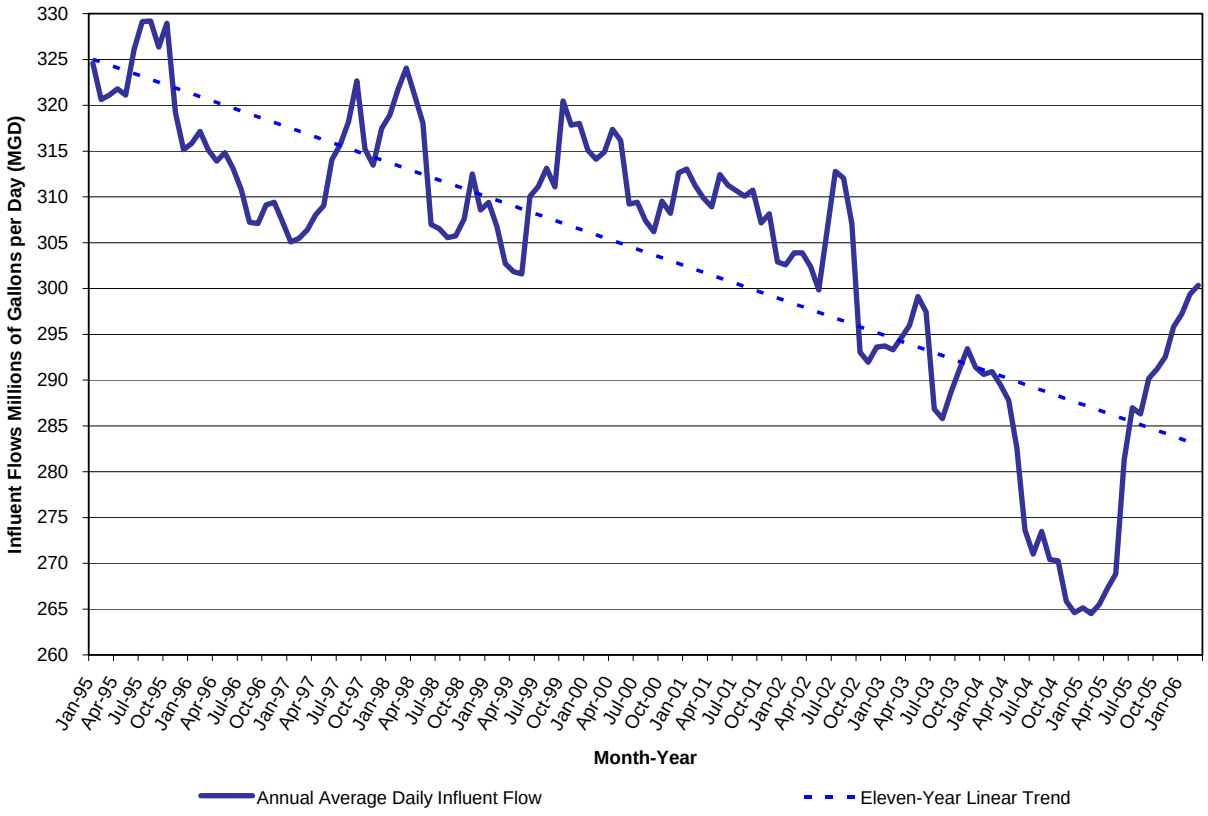


Figure 2. Influent Flows of MDWASD Regional Wastewater Treatment Plants

CHAPTER 3 THE MIAMI-DADE WATER AND SEWER DEPARTMENT'S CONSENT DECREE EXPERIENCE

3.0 WHAT DID WE ACCOMPLISH?

EPA regulators such as Roy Herwig, a former enforcement officer from the agency's Atlanta office, noted that Miami-Dade County put together a "tremendous program" meeting all of the milestones associated with the FPCD and SFPCD on or ahead of the stipulated compliance date with no fines assessed. In fact, as of April 2006, over 1000 milestones have been completed.

The key accomplishments in MDWASD's Consent Decree Program are as follows:

- Completion of over 500 pump station projects and over 200 force main projects as part of the Pump Station Improvement Program (PSIP)
- Implementation of an aggressive Infiltration/Exfiltration/Inflow (I/E/I) Reduction Program which involved extensive sewer inspections and rehabilitation
- Implementation of a pump station inspection and repair program
- Installation of pump station remote monitoring equipment (SCADA) on all MDWASD pump stations
- Enactment of the Grease Trap and Volume Sewer Customer Ordinances
- Elimination of illegal storm water connections
- Replacement of the 72" Cross Bay force main with a 102" force main
- Implementation of a Comprehensive Maintenance Program and Tracking System
- Improvements at the three wastewater treatment plants (WWTP), including the installation of odor control facilities at the Central District WWTP
- Development of a collection and transmission system model
- Optimization of the WWTPs
- Implementation of Supplemental Environmental Programs (SEPs) to provide for effluent reuse and water conservation
- Development of various contingency and short term collection system plans

The I/E/I Reduction Program and PSIP, created to comply with the requirements of the judicial orders, have become part of MDWASD's normal operations and ordinances mandated for

enactment continue to be enforced. As a result of the implementation of these programs, the pump station run times in MDWASD's system have dropped significantly. The Nominal Average Pump Operating Time (NAPOT), the criteria utilized in the FPCD, has been reduced from a system average of 11 hours per day to less than 5 hours per day (see **Figure 3**). The I/E/I Reduction Program rehabilitation efforts have resulted in reduced average flows to the treatment plants even though there has been substantial population growth in the area served by MDWASD and its volume sewer customer (see **Figure 2**).

One of the biggest impacts in controlling MDWASD's SSOs came from maintenance program improvements. MDWASD now closely monitors and frequently inspects the collection and transmission system, and has developed a comprehensive preventive maintenance program. MDWASD has improved its pump service record from about 80% of its pumps in service to having 99% of its pumps available for operation at all times. Over 75 spare pumps and rotating assemblies are kept on hand to reduce downtime due to shipment of spare parts and standardization of equipment now allows the MDWASD to pull out inoperable pumps and replace them with shelved pumps to maintain their high level of service. In addition, O&M improvements have resulted in a reduced backlog of maintenance requests from about four months to approximately two weeks. More importantly, there have been no capacity related overflows since 2001. **Figure 4** depicts MDWASD's reduction in SSOs.

3.1 WHAT DID WE LEARN?

3.1.1 Program Impacts

The EPA estimates that publicly owned sewer systems account for approximately 724,000 miles of sewer pipe and approximately 500,000 miles of privately owned pipes deliver wastewater into these system. Since 1970, total public investment in wastewater infrastructure (capital) and O&M exceeded $658.4 billion. The current capital investment by federal, state, and local sources in wastewater infrastructure is $13 billion per year with O&M costs exceeding $18 billion per year. These figures have a powerful impact on watershed communities' budgets. In fact, some utilities feel that there should be some cost sharing with the federal government as current EPA regulations could not have been anticipated in the 1800s when many systems were built.

Miami-Dade County agrees. The County has spent nearly $1 billion to rehabilitate the largest wastewater collection and treatment system in the Southeast. The EPA required that 20% of MDWASD's gravity system, which was nearly 13 million linear feet at the time, be evaluated annually in order to meet the stringent Consent Decree deadlines. This required that inspection crews dramatically increase the number of inspections per day, which cost 200 to 800 overtime hours per worker in 1995. As a result of these and other program costs, monthly water and sewer bills have more than doubled since 1988.

Although County officials acknowledged that repairs were overdue, they also indicated that the settlements with the FDEP and the EPA duplicated reporting requirements and put construction before design. Completion of a required peak flow study, currently underway, and sanitary sewer evaluations and repairs prior to mandated pump station upgrades, would have generated a more cost-effective plan. It was generally felt that PSIP expenditures were unnecessary in some cases because of the order in which MDWASD was forced to perform work and that PSIP

deadlines were excessively stringent with compliance dates ahead of the I/E/I Reduction Program deadlines, rather than vice-versa, which would have been a more logical approach.

Millions of dollars could have been saved in achieving the same goals. The requirements were sometimes overlapping, mandating elimination of all sanitary sewer overflows even though EPA has yet to develop a national SSO policy and states in its 2004 Report to Congress that it is not feasible to eliminate all SSOs. In addition, it was felt that the EPA's regional offices do not apply the same standards across the board to releases of raw or untreated sewage from sanitary collection systems. For example, the City of Houston had the advantage of conducting a detailed water quality study that guided the design of their whole program. MDWASD wasn't given that opportunity.

MDWASD's Associate Director and Professional Engineer, John Chorlog, has been involved in the Consent Decree Program almost from its inception. When asked what the EPA should have done differently, in regards to Consent Decree requirements, he cites working upstream and creating upstream capacity. A downstream to upstream progression of construction would have avoided the creation of bottlenecks. John adds that the transmission system upgrades should have been coordinated with treatment and disposal upgrades. The implementation of capacity improvements in a manifolded system needs to start at the downstream end of the system and work upstream (uncorking) to correct capacity deficiencies so that each improvement can be made with the downstream capacity restrictions removed. This approach may accelerate those projects near the treatment plants and place a lower priority on those projects further away to allow sufficient time to develop appropriate final design information.

Chorlog's ideal approach would have been to conduct the Peak Flow Management Study first concurrently with the I/E/I Reduction Program. Then follow with the Pump Station Improvement Program. He also notes that in retrospect, since Miami-Dade County has a high water table, dry defects should have been addressed first as well as basins with a high rain dependent I/I (RDII). However, the I/E/I Reduction Program's refocusing in 1999 addressed this issue.

3.1.2 Lessons Learned

MDWASD learned some valuable lessons, not only in the negotiations with EPA and FDEP, but also in implementing a Consent Decree Program of this magnitude. The ideal scenario would be to prevent enforcement actions altogether by adequately planning and investing in a comprehensive maintenance, rehabilitation and upgrade program. It is paramount to continually monitor the wastewater facilities and system operations to identify potential problem areas as it is easier to negotiate with EPA engineers than with the attorneys from the Department of Justice (DOJ). The focus quickly turns from finding the best solutions to costly programs, stipulated penalties and inflexible compliance dates. The cost-effectiveness of improvements and affordability of the Miami-Dade County Consent Decrees were factors that were never acknowledged by the DOJ attorneys. The DOJ also appears eager to obtain cash penalties rather than to allow Supplemental Environmental Projects (SEPs).

If enforcement actions are inevitable, it is recommended that a resource of people be assigned to prepare for litigation in the event that a reasonable settlement cannot be negotiated. It's also advisable to involve all volume sewer users in negotiations. In addition, the program management approach, whether staffed in-house or by consultants is highly recommended. Having a group specifically designated to organize the entire Consent Decree effort (e.g.

tracking construction and repair deadlines, monitoring compliance, etc.) with executive authority to expedite program activities and streamline procedures resulted in the completion of complex projects within the stipulated time frames.

If at all possible, one enforcement action should be negotiated that satisfies the demands of all regulators. Having separate enforcement actions with the FDEP and the EPA for, in many cases, the exact same improvement was a major problem for Miami-Dade County. There were different and sometimes conflicting methodologies used by the enforcement agency personnel. The most difficult hurdle was that DOJ did not acknowledge the requirements of the FDEP agreement.

The importance of carefully analyzing the order specified for task completions in regulatory actions, prior to committing to them cannot be overstated. The enforcement action should allow the agency to complete improvements in a logical fashion that results in the best long-term solution for the deficiency that is being corrected. For example, a sensible approach would have been to first complete the Peak Flow Management Study, currently being implemented which would have detailed the most cost-effective means to handle peak flows in order to minimize SSOs. This Study would determine whether I/I corrections, or increased transmission system capacity (i.e., larger pump stations and force mains) would be the best way to minimize SSOs. Sufficient time should also be allowed to conduct a comprehensive sanitary sewer evaluation survey (SSES), before any I/I corrections are required to be implemented and prior to pump station upgrades. Otherwise, improvements are made which may not be the optimal, most cost-effective solution.

In addition, do not commit to eliminating all overflows. This goal is not feasible. In fact, in EPA's August 2004 Report to Congress, it is stated that, "Most technologies and operating practices are designed to reduce, not eliminate the discharge of pollutants and attendant impacts because it is generally not feasible to eliminate all discharges."

Lastly, maintain good internal records. Until MDWASD found itself involved in enforcement actions, little attention was given to documenting the occurrence of SSOs and the corresponding corrective measures. During negotiations with the EPA, MDWASD went through a very labor-intensive exercise of trying to research and reconstruct over twenty years of unscheduled maintenance records. Consequently, the Department's negotiating position against the enforcement agencies' accusations was very difficult to defend. Once the extent of the documentation problem was discovered, MDWASD revised its reporting practices and implemented a comprehensive SSO event-tracking database. This database contains information on all known SSO events which have occurred in Miami-Dade County from January 1, 1993 through the present day. Records include information on the date of the overflow event, the location, cause, corrective action proposed/taken, unusual conditions, associated rainfall event, overflow volume, and destination (i.e. directly to surface water, not to surface water and/or to catch basins)

To summarize:

- Prevent and avoid enforcement actions
- If enforcement actions are inevitable, prepare for litigation
- Only one enforcement action should be negotiated that satisfies the demands of all regulators
- Enforcement actions should allow the agency to complete improvements in a logical fashion
- Do not commit to eliminating all overflows

- Maintain good internal records

3.2 WHAT DO WE RECOMMEND?

3.2.1 Model Future Judicial Actions Using Alternate Approaches

According to the EPA's August 2004 Report to Congress, twenty-six federal judicial actions have been brought against municipalities in Regions 1-6 and Region 9 for SSO violations since 1995. Between 1994 and 2003, 78 Administrative Penalty Orders (APOs) were issued to municipalities in Regions 1-7 and Region 10 for SSO violations. These municipalities would be better served by following a different methodology than that which was employed with Miami-Dade County.

For example, EPA Region VI and the State of Texas chose a progressive approach and allowed the City of Houston to utilize best available control technology in developing an SSO control program to comply with an Administrative Order. The City of Houston was able to conduct a comprehensive SSES, peak flow studies and water quality studies before constructing capital-intensive improvements to their system. Based on water quality studies, the City was able to convince the State and the EPA that no benefit would be received by constructing improvements beyond the 2 year, 6 hour storm event. By decreasing the design storm from the 5 year, 6 hour storm originally selected, the City saved $600 million.

Another positive approach involves the East Bay Municipal Utility District (EBMUD) which supplies water and provides wastewater treatment for parts of Alameda and Contra Costa counties on the eastern side of San Francisco Bay in northern California. Due to permit violations, the EBMUD was required to implement corrective actions to control SSOs. After conducting a comprehensive SSES, the EBMUD discovered that excessive I/I was responsible for the average dry to peak wet weather flow ratio of 1 to 18.75. Moreover, water quality studies showed that the receiving water had high levels of coliforms, and the wet weather SSOs were found to be a major source of coliforms. Based on the results of the studies, the EBMUD developed a cost-effective program to address these issues by reducing I/I by 30 percent through rehabilitation of the collection system, and by increasing conveyance and treatment capacity by 270% through the construction of pump stations, relief sewers and four upstream WWTFs.

As shown by Houston and the EBMUD, an SSO Control Program must be designed around site-specific conditions, and should contain flexible time schedules to implement the different phases of the program, from the commencement of studies to the completion of long-term capital improvements.

3.2.2 Uniform SSO Policy

In 1994, a number of municipalities asked the EPA to establish an SSO Federal Advisory Committee (FAC) of key stakeholders. The municipalities indicated a desire for greater clarity, consistency in NPDES requirements applicable to SSOs, and a workable regulatory framework. In 1995, the EPA chartered an Urban Wet Weather Flows FAC, who formed their own SSO Subcommittee which is tasked with developing a framework to address SSOs and their impacts through regulatory and non-regulatory actions.

Based on MDWASD's experience in implementing the Consent Decree Program, its dealings with multiple regulatory agencies, and its observations of how other utilities and regulators are addressing SSOs, it is clear that a National SSO Policy is essential. In the absence of such a policy, there is no uniformity in interpreting current regulations, no nationwide consistency in addressing SSOs, and no assurance that a utility will be in compliance after spending millions of dollars on infrastructure improvements.

3.2.3 Moving Forward: Region 4's CMOM Program

There's no arguing with the fact that proper operations and maintenance of the nation's infrastructure will result in reduced volume and frequency of SSOs and maintain the level of environmental quality enjoyed in the United States. Currently, there is no standard approach for determining the optimal frequency of various maintenance procedures. However, several EPA regions and states, as well as professional organizations have initiated efforts to develop such an approach. These include EPA Region 4's CMOM Program.

CMOM is the acronym for Capacity, Management, Operations, and Maintenance Program and is currently being implemented in cooperation with states in Region 4. The CMOM Program was modeled after the EPA requirements contained in Miami-Dade County's Consent Decrees. Since EPA's Consent Decree experience with Miami-Dade County provided the basis for the Program, Miami-Dade County's operations and maintenance practices are in keeping with CMOM.

CMOM encourages all NPDES permit holders and any associated satellite utilities to participate in a proactive approach to managing, operating, and maintaining their sewer systems. Utilities that implement good CMOM Programs benefit by reducing the likelihood of Clean Water Act violations, extending the life of their infrastructure, and providing better customer service through steady rates and greater efficiency. The goal of the CMOM Program is to bring 100 percent of the POTWs handling domestic wastewater in Region 4 into compliance with the "proper operation and maintenance" provision of their NPDES permits by 2011.

As part of the CMOM Program, selected sewer system operators are expected to provide a self-evaluation report to their respective EPA region. This report identifies improvements that can be made and the schedules necessary to make those improvements. In instances where the utility does not conduct an evaluation, Region 4 conducts its own site inspection. Through voluntary participation in the program and by self-disclosing any needed improvements, participants may be eligible for a reduction in civil penalties while under a remediation schedule.

3.2.4 Conclusion

Since the FPCD, MDWASD has increased its transmission capacity by at least 38% based on the ability to increase flow to its treatment plants. MDWASD has installed over 70 miles of force mains including the 102" diameter Bay Crossing, and added 239 miles of new gravity sewer mains. MDWASD also has increased its treatment capacity by 30% and has recovered millions of gallons per day of capacity through I/I reduction in the collection system, dramatically reducing the number of SSOs.

As has been demonstrated by MDWASD's experience, costs associated with the technologies for controlling SSOs are substantial. In fact, the EPA estimated that it would require $88.5 billion

in capital improvements to reduce the frequency of SSOs caused by wet weather and other conditions such as blockages, line breaks or mechanical failure. In order to spread the extensive cost burden over time, communities should be allowed to develop and implement long-term programs, which take into consideration system specific factors, with flexible time schedules and a logical progression of remedial programs.

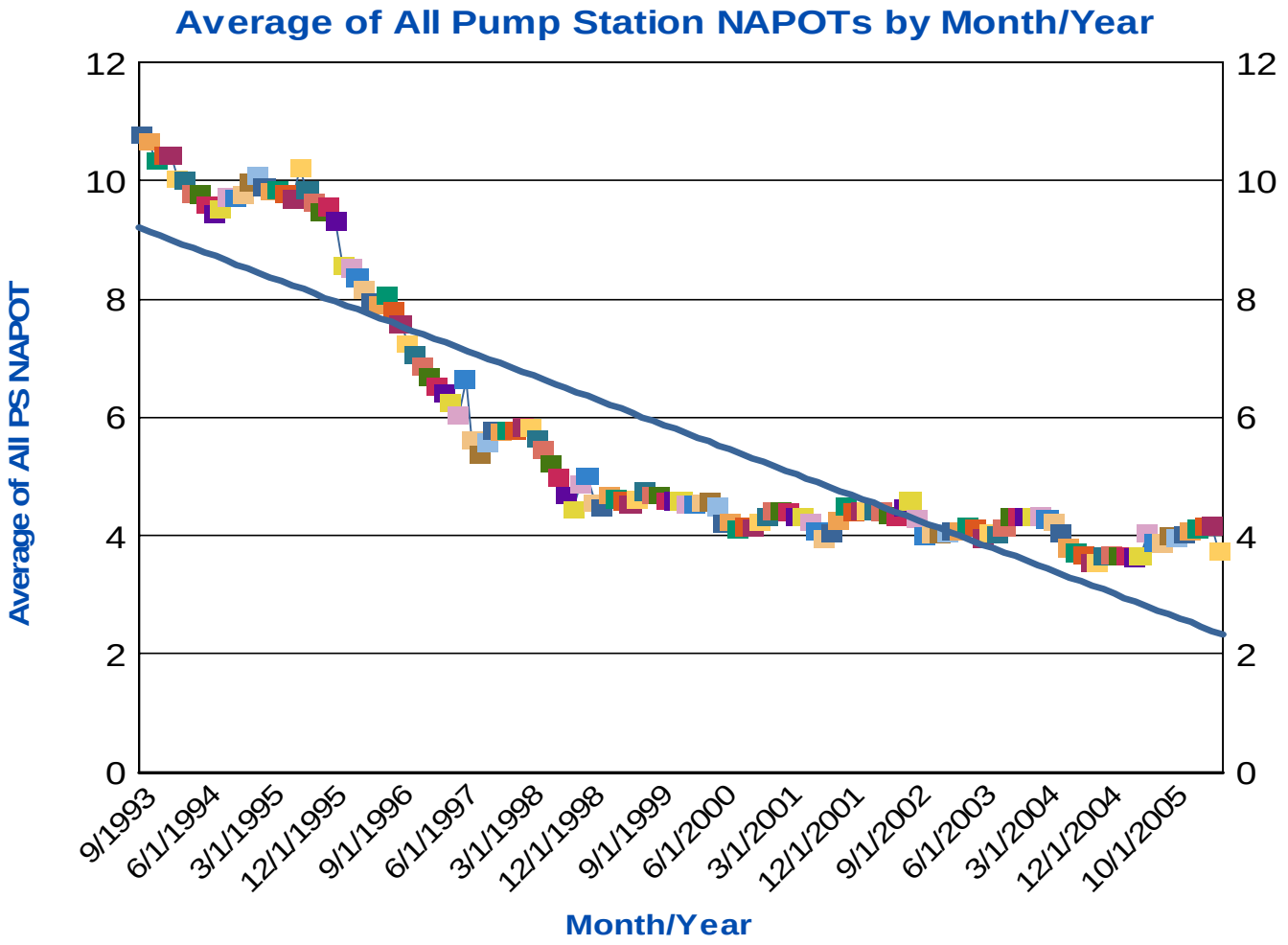


Figure 3. NAPOT Reduction Trend

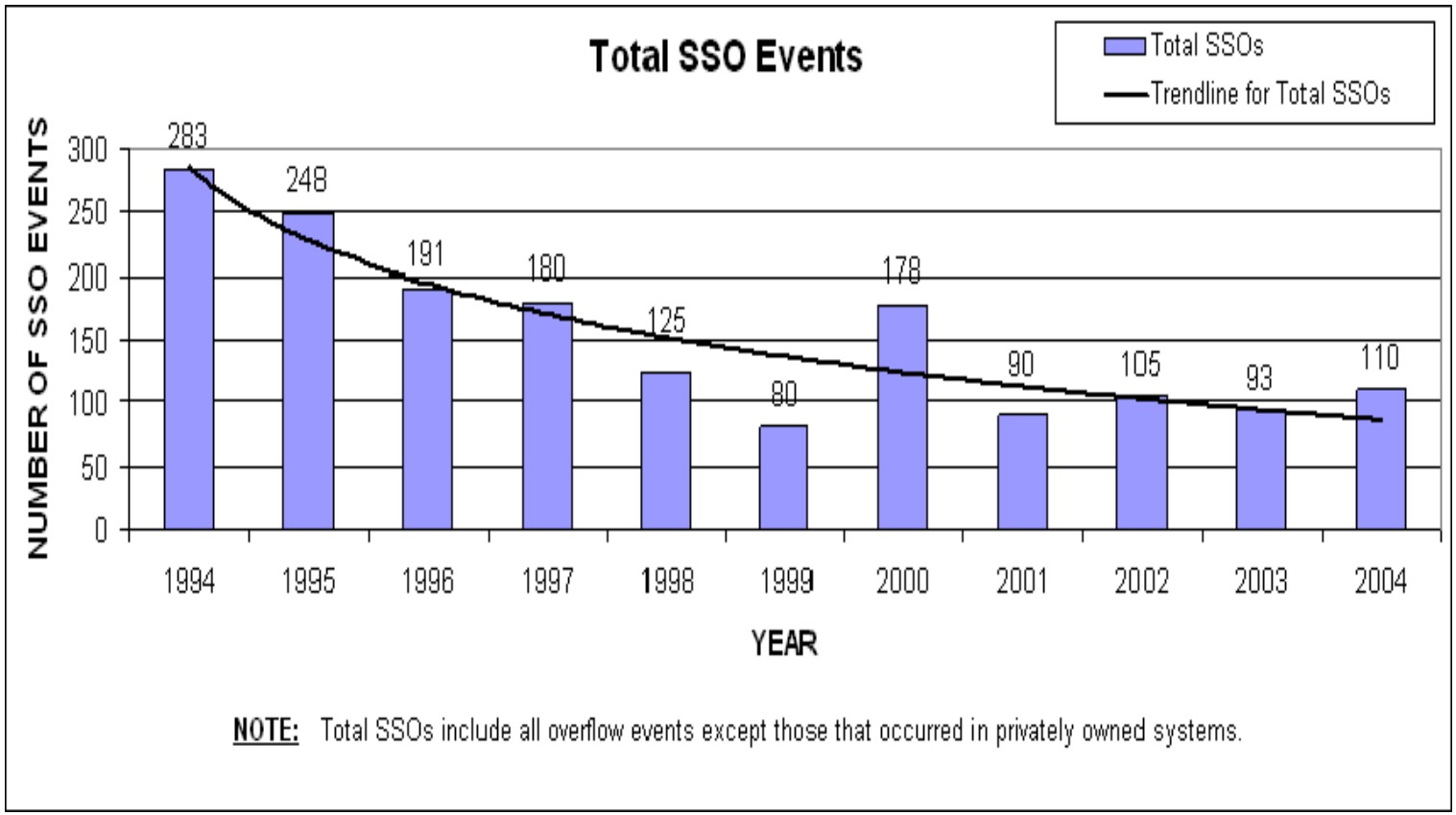


Figure 4. SSO Reduction Trend

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